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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
p	preliminary
r	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

The Cumulative Earnings of Postsecondary Graduates Over 20 Years: Results by Field of Study

by Yuri Ostrovsky and Marc Frenette, Social Analysis and Modelling Division (SAMD)

This article in the *Economic Insights* series reports on the cumulative earnings over a 20-year period of college and bachelor's degree graduates from different fields of study. This article is part of a program at Statistics Canada that examines various dimensions of labour market outcomes of postsecondary graduates.

Introduction

When students graduate from high school, they make at least two educational decisions that affect the rest of their lives. The first is whether to pursue a higher level of education. The literature clearly demonstrates that postsecondary graduates tend to fare better in terms of labour force participation, unemployment, and earnings than do people with less education.

Students who choose to enter a postsecondary program must make a second decision: what to study. Canadian evidence on labour market outcomes by field of study is limited. Research has generally been based on cross-sectional information[1] or on longitudinal data with limited scope;[2] until recently, national-level data have not been available to observe and quantify long-term cumulative outcomes associated with education. However, with the development of new, national longitudinal administrative data, this is now possible. A recent study, in fact, found considerable differences in cumulative earnings across levels of educational attainment.[3]

This study extends that research by examining the cumulative employment earnings of graduates of different fields of study over a 20-year period. Employment earnings include paid wages and salaries, as well as net proceeds from self-employment. The analysis is based on a sample of 15,166 college and bachelor's degree graduates who were aged 26 to 35 in 1991. Information about their level of education and field of study was obtained from their responses to the 1991 Census long questionnaire; information about their employment earnings over the subsequent 20 years was taken from their T1 Income Tax Returns.[4] This study documents three aspects of earnings by field of study: (i) differences in median cumulative earnings across fields of study; (ii) the distribution of cumulative earnings within fields of study; and (iii) the trajectories of annual median earnings within fields of study over the life course of graduates.

Cumulative earnings vary by level and field of study

Bachelor's degree and college graduates earned considerably more than did high school graduates. From 1991 to 2010, the median cumulative earnings (expressed in 2010 constant dollars) of male high school graduates amounted to $882,300 (Table 1). In comparison, male college graduates earned about 1.3 times more ($1,137,000), and male bachelor's degree graduates earned about 1.7 times more ($1,517,200).

Although women generally earned less than men did, the patterns were similar. Women with a bachelor's degree earned $972,500 (about 2.1 times more than high school graduates), and those with a college certificate earned $643,200 (about 1.4 times more than high school graduates).

Postsecondary graduates' earnings also varied considerably across fields of study. For example, men with a bachelor's degree in Engineering earned $1,845,000 over the period, more than twice as much as Fine and Applied Arts graduates, who earned $843,900. Men with a bachelor's degree in Business Administration, Health, and Mathematics and Physical Sciences were also top earners; those who graduated with a degree in Humanities ranked relatively low (second behind Fine and Applied Arts graduates).

The findings were generally similar for women with a bachelor's degree. Top earners again included those who graduated from Business Administration, Mathematics and Physical Sciences, Health, and Engineering. A notable difference between men and women was the relative ranking of Education graduates. Among men, they ranked seventh out of the nine fields. Among women, they ranked fourth—just behind Health graduates and slightly ahead of Engineering graduates. As was the case with male bachelor's degree graduates, the lowest earners among women with a bachelor's degree were those who had studied Fine and Applied Arts.

1. See Finnie and Frenette (2003).
2. See Heisz (2003).
3. See Frenette (2014).
4. Although it is possible that some individuals upgraded their education after 1991, they cannot be identified in the tax data. Nevertheless, supplementary analysis of Labour Force Survey data suggests that the prevalence of educational upgrading among this age group is likely quite low. See "Data sources" for a more detailed discussion.

Table 1
Median cumulative earnings by sex, level of education, and field of study

	Men			Women		
	Bachelor's degree	College certificate	High school diploma	Bachelor's degree	College certificate	High school diploma
	2010 constant dollars					
Education	1,290,400	996,600	...	1,044,600	513,500	...
Fine and Applied Arts	843,900	807,200	...	652,100	437,300	...
Humanities	1,144,600	827,500	...	808,200	555,900	...
Social Sciences	1,358,900	1,241,500	...	824,300	563,800	...
Business Administration	1,619,400	1,099,500	...	1,169,100	625,100	...
Life Sciences	1,334,700	753,500	...	844,900	502,300	...
Engineering	1,845,000	1,244,200	...	972,600	718,800	...
Health	1,627,600	1,089,700	...	1,094,000	812,800	...
Mathematics and Physical Sciences	1,607,500	1,128,000	...	1,148,700	793,800	...
All fields of study	1,517,200	1,137,000	882,300	972,500	643,200	458,900

... not applicable

Sources: Statistics Canada, 1991 Census–Longitudinal Worker File and CANSIM table 326-0021.

Male and female college graduates of Fine and Applied Arts programs also ranked near the bottom based on median cumulative earnings (second lowest among men; lowest among women).

For men and women with a college certificate, top earners included graduates of Engineering, Health, Mathematics and Physical Sciences, and Business Administration (as was the case for bachelor's degree graduates). Interestingly, male college Social Sciences graduates ranked second in median cumulative earnings (just behind Engineering graduates). In contrast, the median cumulative earnings of men with a bachelor's degree in Social Sciences were well below the median for all fields of study.

Cumulative earnings also vary substantially within each field

Even if students select the same field of study, their long-term earnings can be quite different. This may be the result of factors such as hours of work, occupation, industry, access to employment networks, abilities and random luck—information not available in the administrative data used in this analysis. Nonetheless, quantifying variability within fields provides perspective on long-term earnings prospects.

To do this, men and women with a college certificate or a bachelor's degree in each field were ranked from lowest to highest in terms of their cumulative earnings. Their "normalized" cumulative earnings are shown in Tables 2 and 3 at the 10th percentile (P10), 25th percentile (P25), median or 50th percentile (P50), 75th percentile (P75), and 90th percentile (P90). Normalized values are expressed relative to the median for all fields combined. The ratios of cumulative earnings of individuals at the 75th and 25th percentiles (the P75/P25 ratio) and at the 90th and 10th percentiles (the P90/P10 ratio) were used as measures of earnings variation within disciplines.

There was considerable earnings variation in cumulative earnings in every discipline, as evidenced by the P75/P25 and the P90/P10 ratios. The P75/P25 ratio ranged from about 1.6 (registered by men with a bachelor's degree in Education) to about 3.8 (men with a bachelor's degree in Fine and Applied Arts). The P90/P10 ratio ranged from about 2.7 (men with a bachelor's degree in Education) to about 16.2 (women with a bachelor's degree in Fine and Applied Arts).

In general, the variation in cumulative earnings within fields of study was higher among women. This was largely attributable to lower earnings at the bottom of the distribution, both in an absolute and a relative sense.

An alternative way to visualize the variability in cumulative earnings within and across fields of study is through a three-dimensional chart. For instance, Figure 1 pertains to men with a bachelor's degree. The fields are sorted from left to right in descending order of cumulative earnings at the 90th percentile.

The "very high" earners (those whose cumulative earnings amounted to at least $2,500,000 over the 20-year period—an annual average of at least $125,000) are at the top (90th percentile) of the distributions in five fields: Business Administration, Mathematics and Physical Sciences, Engineering, Social Sciences, and Health. The cumulative earnings of men at the 90th percentile of the distribution of Business Administration graduates amounted to slightly more than $4,000,000 over the period. This means that about 10% of male graduates with a bachelor's degree in Business and Administration had average annual earnings of $200,000 or more during the two decades.

Some graduates in other fields who were above the 90th percentile in their respective discipline may also have been "very high" earners (cumulative earnings of more than $2,500,000). However, the earnings of graduates of these disciplines (even those at the 90th percentile) were comparatively low. For example, the cumulative

Table 2
Normalized cumulative earnings at selected percentiles (P) by sex and field of study, bachelor's degree graduates

	P10	P25	P50	P75	P90	P75/P25	P90/P10
	normalized value[1]					ratio	
Men							
Education	0.41	0.63	0.85	1.00	1.12	1.58	2.75
Fine and Applied Arts	0.15	0.24	0.56	0.89	1.09	3.77	7.54
Humanities	0.21	0.40	0.75	1.06	1.53	2.62	7.46
Social Sciences	0.41	0.65	0.90	1.21	2.15	1.86	5.21
Business Administration	0.53	0.77	1.07	1.63	2.68	2.10	5.07
Life Sciences	0.46	0.62	0.88	1.10	1.43	1.77	3.14
Engineering	0.64	0.93	1.22	1.57	2.20	1.68	3.44
Health	0.67	0.86	1.07	1.40	1.96	1.63	2.93
Mathematics and Physical Sciences	0.52	0.80	1.06	1.46	2.61	1.82	5.02
All fields of study	0.45	0.71	1.00	1.37	2.19	1.94	4.89
Women							
Education	0.33	0.66	1.07	1.35	1.58	2.06	4.75
Fine and Applied Arts	0.08	0.30	0.67	1.05	1.33	3.51	16.17
Humanities	0.18	0.47	0.83	1.31	1.62	2.76	9.20
Social Sciences	0.25	0.49	0.85	1.24	1.59	2.54	6.32
Business Administration	0.36	0.77	1.20	1.69	2.29	2.21	6.28
Life Sciences	0.12	0.47	0.87	1.22	1.49	2.61	12.60
Engineering	0.30	0.56	1.00	1.58	1.81	2.81	6.13
Health	0.46	0.80	1.13	1.36	1.67	1.71	3.65
Mathematics and Physical Sciences	0.29	0.70	1.18	1.53	2.01	2.19	6.85
All fields of study	0.29	0.58	1.00	1.36	1.69	2.34	5.87

1. Normalized cumulative earnings refer to the cumulative earnings (in 2010 constant dollars) at a given percentile and in a given field of study expressed relative to the median cumulative earnings across all fields of study.

Sources: Statistics Canada, 1991 Census–Longitudinal Worker File and CANSIM table 326-0021.

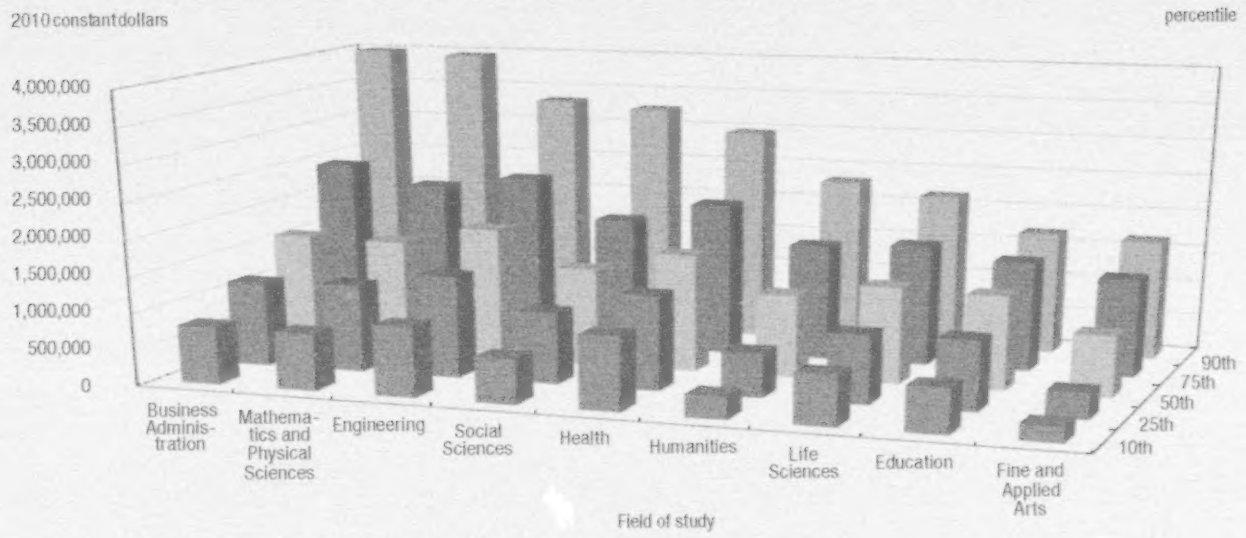
Table 3
Normalized cumulative earnings at selected percentiles (P) by sex and field of study, college graduates

	P10	P25	P50	P75	P90	P75/P25	P90/P10
	normalized value[1]					ratio	
Men							
Education	0.41	0.62	0.88	1.09	1.49	1.75	3.67
Fine and Applied Arts	0.28	0.47	0.71	1.11	1.44	2.36	5.16
Humanities	0.24	0.43	0.73	0.99	1.28	2.30	5.44
Social Sciences	0.49	0.81	1.09	1.42	1.59	1.76	3.25
Business Administration	0.39	0.67	0.97	1.35	1.81	2.01	4.69
Life Sciences	0.25	0.44	0.66	0.87	1.11	1.99	4.41
Engineering	0.44	0.76	1.09	1.43	1.80	1.89	4.09
Health	0.34	0.72	0.96	1.20	1.45	1.68	4.26
Mathematics and Physical Sciences	0.35	0.64	0.99	1.37	2.13	2.15	6.09
All fields of study	0.38	0.68	1.00	1.36	1.71	2.00	4.46
Women							
Education	0.14	0.43	0.80	1.26	1.66	2.94	11.68
Fine and Applied Arts	0.10	0.31	0.68	1.11	1.51	3.54	14.97
Humanities	0.15	0.45	0.86	1.30	1.88	2.92	12.56
Social Sciences	0.17	0.46	0.88	1.37	1.79	2.97	10.70
Business Administration	0.20	0.52	0.97	1.37	1.80	2.63	9.13
Life Sciences	0.12	0.42	0.78	1.16	1.52	2.80	12.81
Engineering	0.27	0.53	1.12	1.69	2.42	3.17	8.98
Health	0.35	0.79	1.26	1.73	2.11	2.19	6.04
Mathematics and Physical Sciences	0.34	0.74	1.23	1.68	2.46	2.25	7.19
All fields of study	0.21	0.53	1.00	1.46	1.93	2.77	9.43

1. Normalized cumulative earnings refer to the cumulative earnings (in 2010 constant dollars) at a given percentile and in a given field of study expressed relative to the median cumulative earnings across all fields of study.

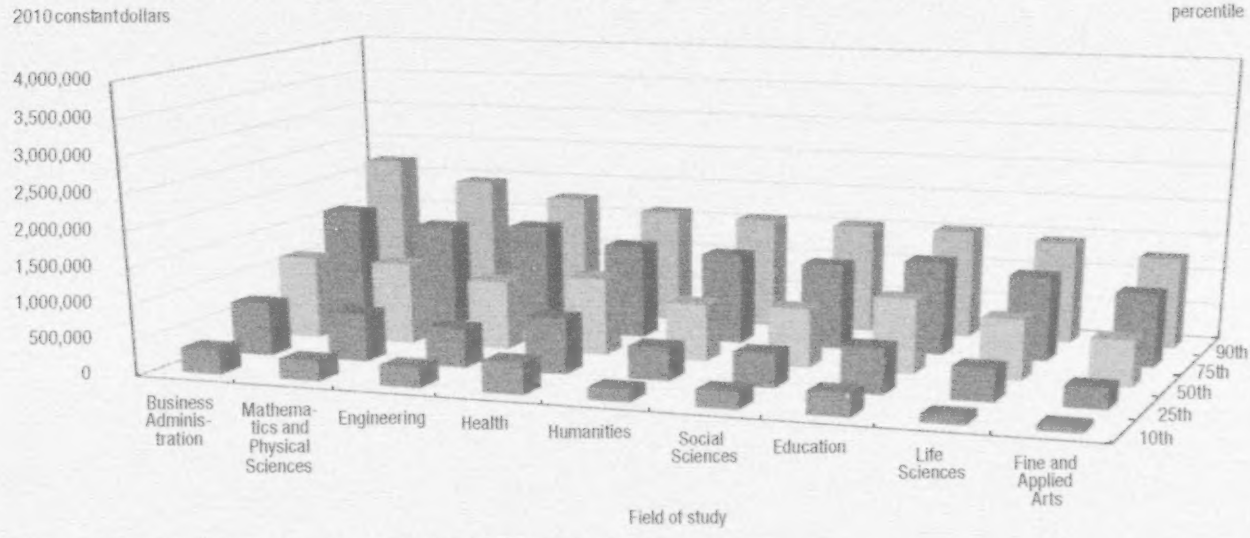
Sources: Statistics Canada, 1991 Census–Longitudinal Worker File and CANSIM table 326-0021.

Figure 1
Cumulative earnings of male bachelor's degree graduates by field of study and percentile, 1991 to 2010



Sources: Statistics Canada, 1991 Census-Longitudinal Worker File and CANSIM table 326-0021.

Figure 2
Cumulative earnings of female bachelor's degree graduates by field of study and percentile, 1991 to 2010



Sources: Statistics Canada, 1991 Census-Longitudinal Worker File and CANSIM table 326-0021.

earnings of men with a bachelor's degree in Education and Fine and Applied Arts who were at the 90th percentile amounted to about $1,700,000 over the 20-year period.

At the opposite end of the spectrum, men at the 10th percentile of the earnings distribution of Fine and Applied Arts graduates earned $222,300 (an annual average of $11,015). Men at the 10th percentile of Humanities graduates earned $311,700 ($15,585 per year).[5]

5. These low earnings are not attributable to people leaving Canada for significant periods, because to be included in this analysis, individuals must have appeared in the tax files in at least 18 of the 20 years. Also, earnings include net proceeds from self-employment. Furthermore, these results were not driven by negative net self-employment income among graduates in these disciplines. When earnings were restricted to T4 wages and salaries, men at the 10th percentile of the distribution of Fine and Applied Arts graduates earned even less ($63,300 over the period, or an annual average of $3,165). Finally, since they are men, and since women are generally the primary childcare providers within families, it is unlikely that the results are driven by voluntary withdrawal from the paid labour force to take care of children. One possible explanation that cannot be ruled out is that these graduates simply have not been very successful in the labour market (e.g. they may have relied on social assistance for a substantial portion of the period). Unfortunately, the Longitudinal Worker File does not contain family-level information, which would be required to accurately measure reliance on social assistance.

Table 4
Median annual earnings by sex, field of study, 1991 and 2010

	Bachelor's degree graduates			College graduates		
	1991	2010	Change	1991	2010	Change
	2010 constant dollars					
Men						
Education	51,100	78,100	27,000	39,600	55,200	15,600
Fine and Applied Arts	22,900	42,000	19,100	34,800	42,500	7,700
Humanities	40,800	71,300	30,500	35,700	45,400	9,700
Social Sciences	52,300	78,200	25,900	56,600	72,400	15,800
Business Administration	57,800	95,200	37,400	45,100	60,900	15,800
Life Sciences	51,800	77,800	26,000	29,900	44,800	14,900
Engineering	66,400	105,300	38,900	51,100	70,300	19,200
Health	67,400	92,400	25,000	50,400	61,500	11,100
Mathematics and Physical Sciences	61,900	90,000	28,100	50,900	65,000	14,100
All fields of study	57,400	87,800	30,400	47,600	63,900	16,300
Women						
Education	39,200	69,600	30,400	22,500	31,800	9,300
Fine and Applied Arts	21,300	34,200	12,900	13,400	26,600	13,200
Humanities	31,500	51,800	20,300	23,200	35,600	12,400
Social Sciences	32,600	54,300	21,700	20,700	35,500	14,800
Business Administration	45,500	73,200	27,700	25,700	39,100	13,400
Life Sciences	33,700	58,900	25,200	21,200	29,500	8,300
Engineering	53,900	56,400	2,500	29,800	43,900	14,100
Health	46,800	70,500	23,700	32,700	50,600	17,900
Mathematics and Physical Sciences	46,900	67,100	20,200	36,000	46,800	10,800
All fields of study	38,500	64,100	25,600	26,400	39,600	13,200

Sources: Statistics Canada, 1991 Census–Longitudinal Worker File and CANSIM table 326-0021.

Similar findings are evident for women with a bachelor's degree (Figure 2). Although the ordering of disciplines at the 90th percentile is slightly different, the highest earners were once again from Business and Administration, Mathematics and Physical Sciences, Engineering, and Health. The lowest earners at the 10th percentile were from Fine and Applied Arts and Life Sciences graduates.

Absolute change in median annual earnings similar in most fields

Graduates of the various disciplines likely bring unique skills to the labour market, which may be valued or rewarded differently over time. For example, technical skills may yield greater returns early in one's working life when an individual is at the forefront of the most recent technology; interpersonal skills may yield greater returns at later stages when individuals move into supervisory or managerial positions. Although such factors could have implications for the earnings trajectories of graduates of different fields of study, this is not the case when median annual earnings are tracked through the study period.

Real median annual earnings at the beginning (1991) and end (2010) of the study period are shown in Table 4. Also shown is the change between these two years.

Within each sex and education category, most fields experienced similar absolute changes in median annual earnings over the period. Among men with a bachelor's degree, the absolute change in median annual earnings ranged from $25,000 to $31,000 in six out of the nine fields of study. Similarly, among women with a bachelor's degree, the absolute change in median annual earnings ranged from $20,000 to $28,000 in six out of the nine fields of study. Among college graduates, the absolute changes in median annual earnings were even more consistent across disciplines. Note that the relative changes in median annual earnings (not shown in the table) tended to vary more across fields given the large variation in median annual earnings at the beginning of the period.

Conclusion

A number of key findings emerge from this analysis of the 20-year cumulative earnings of postsecondary graduates by field of study. The first is the considerable variability in median cumulative earnings by level and field of study. Second, even within each field, graduates' earnings varied substantially. Third, the change in median annual earnings was similar for graduates of most fields over the 20-year period.

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Data sources, methods and definitions

Data sources

Data from the 1991 Census of Population file, which was linked to the Longitudinal Worker file (LWF), were used in this study. The LWF combines several administrative files, including the T1 Personal files, and is a 10% random sample of the population receiving a T4 Information Slip or filing a T1 Income Tax Return. Individuals who were at least 25 years old on the 1991 Census were linked probabilistically to the LWF with a success rate of more than 75%; however, only 75% of the original sample was maintained in the linked file (based on random selection). The individuals who were successfully linked and maintained in the file were very similar to those in the broader sample of 1991 Census respondents based on several socio-economic characteristics, including highest level of educational attainment.

This study examined 15,166 men and women who, according to the 1991 Census, held a college certificate or a bachelor's degree, were aged 26 to 35 at that time, were born in Canada or came to Canada before age 18, had not attended school in the previous nine months, and appeared in the T1 files in 18 of the next 20 years. The study population consisted of 2,796 men and 3,140 women with a bachelor's degree, and 3,634 men and 5,596 women with a college certificate. The T4 wages and salaries of individuals were tracked in the LWF from 1991 to 2010. Individuals who do not appear in the LWF in a given year were assigned zero T4 wages and salaries.

Although it is possible that some members of the study sample obtained higher educational credentials after 1991, the number is likely small. According to March and September data from the Labour Force Survey (LFS), of all Canadian-born individuals aged 26 to 35 who had a postsecondary credential in 2006 or 2007, 37.6% of them had a bachelor's degree, and 11.3% had a credential above a bachelor's degree. Six years later (in 2012 or 2013), the percentage of individuals who were six years older (but otherwise similar) and had a bachelor's degree was 34.1%, and the percentage with a credential above a bachelor's degree was 15%. The percentage with a college certificate remained steady over the period.

Thus, according to the LFS, about 9% of 26- to 35-year-olds had upgraded their education. However, the current study is restricted to individuals who had not attended school in the nine months before the 1991 Census. In the LFS, 11% of 26- to 35-year-olds who held a bachelor's degree in 2006 and 2007 were still attending school. It is possible that many of them were the people who eventually obtained higher educational credentials, although this cannot be determined because the LFS data are not longitudinal.

Methods

Medians and percentiles are the only statistical techniques employed in this analysis. No regression adjustments were necessary, because the individuals who were compared across and within fields of study shared many important characteristics: they had the same sex; they were about the same age; were born in Canada (or immigrated before age 18); and had the same highest level of education in 1991.

Definitions

Cumulative earnings: This refers to the sum of T4 wages and salaries plus net self-employment income earned from 1991 to 2010, expressed in 2010 constant dollars based on the annual Consumer Price Index (CPI) 2011 basket (CANSIM table 326-0021).

Bachelor's degree: A university degree at the undergraduate level. It excludes university certificates above or below a bachelor's degree, as well as first professional degrees (medicine, dentistry, veterinary medicine, or optometry). This study also excludes graduates of law programs, because a Bachelor of Laws (L.L.B.) is generally considered to be a first professional degree. Non-L.L.B. programs such as legal studies were also excluded, because the specific programs could not be distinguished.

College certificate: A certificate awarded by either a college, CEGEP, or other postsecondary non-university institution (excluding registered apprenticeships or trades certificates). To be consistent with the bachelor's degree category, law programs were excluded.

Field of study: The field of study was identified by the major field of study code used in the 1991 Census. The fields are categorized into nine major groups:

- **Education:** Includes Educational, Recreational and Counselling Services.
- **Fine and Applied Arts:** Includes Fine and Applied Arts.
- **Humanities:** Includes Humanities and Related, as well as No Specialization.
- **Social Sciences:** Includes Social Sciences and Related.
- **Business Administration:** Includes Commerce, Management and Business Administration.
- **Life Sciences:** Includes Agricultural, Biological, Nutritional and Food Sciences.
- **Engineering:** Includes Engineering and Applied Sciences and Science Technologies and Trades
- **Health:** Includes Health Professions and Related.
- **Mathematics and Physical Sciences:** Includes Mathematics, Computer and Physical Sciences.